Overcoming practical constraints in the application of X-ray CT to soil science

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Soil structure and in particular the spatial organization of pores are key factors in regulating soil organic matter (SOM) dynamics and new techniques to study their interactions should be developed and/or refined. X-ray computed tomography (X-ray CT) is rapidly gaining importance as a technique to obtain three dimensional information about the soil structure in a non-destructive manner. However, the application of X-ray CT in soil biological studies has been limited by practical constraints. Firstly, a trade-off factor of 1000-2000 exists between X-ray CT resolution and object dimension and hence to achieve adequate resolution for biological studies sufficiently small soil cores are required (e.g. 10µm resolution for a 1cm diameter soil core = ±1g). However, most enzyme assessments and PLFA analyses require several grams of soil. Secondly, while X-ray CT emits only a low dose of ionizing radiation (±5 Gy), the influence of this dose of ionizing radiation on decomposer organisms is unknown. To date, only the applicability of PLFA signature analysis following X-ray CT has been validated (Deacon et al., 2008), while no information exists on the impact on e.g. subsequent enzyme activity assessments and biological activity following X-ray CT treatments.

Therefore, batch studies with or without X-ray CT scanning, either prior to or during running soil incubation experiments will be set up. These experiments will examine the impact of X-ray CT scanning and/or object dimension on microbial community structure, nematode survival, C-mineralization and enzyme activities (e.g. ß-glucosidase, hydrogenase). Additional factors such as scanning time and soil moisture loss during scanning will be looked at. The outcome of these investigations will provide crucial information on ideal experimental set-ups for using X-ray CT in studies of SOM dynamics.

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